QP Code : 3243

(3 Hours) [Total Marks 80]

N.B (1) Question no. 1 is compulsory
(2) Attempt any **Three** questions from remaining 5 questions.
(3) Assume any **suitable** data if **necessary** and state it very **clearly**.

Q1 **Solve any Four** 20

a Define Moment of Momentum Equation.

b Explain different types of similarities that must exist between prototype and model

c If a centrifugal pump does not deliver any water when started, what may be the probable cause and how can they be remedied.

d Write a short note on Hydraulic Accumulator.

e What is Cavitation in Pump.

f What are the Merits and limitations of distorted models.

Q2 a A pipeline 60 cm diameter, conveying oil (sp. Gr. = 0.85) at the flow rate of 1800 lit/sec has a 90^0 bend in the horizontal plane. The pressure at the entrance to the bend is 1.5 kg/cm^2 and the loss of head in the bend is 2.0 m of oil. Find the magnitude and direction of the force exerted by the oil on the bend and show the direction of the force on a sketch of the bend. 10

b Water is admitted at the axis of rotation of a four arm lawn sprinkler. The nozzle has a diameter of 6 mm. Sprinkler arms have a distance of 28 cm. For a flow of 1.2 lit/sec. find speed of rotation and torque to keep the sprinkler stationary. Neglect friction. 10

Q3 a The performance of a spillway of a power project is to be studied by means of a model constructed to a scale of 1:9. Neglecting the viscous and surface tension effects, determine: 10

(i) Rate of flow in the model for a prototype discharge of 1000 cumec.

(ii) The dissipation of energy in the prototype hydraulic jump, if the jump in the model studies dissipates 294.2 watts (0.4 metric horse power)

b A jet propelled boat, moving with a velocity of 5.5 m/s, draws water amid-ship. The water is discharged through two jets provided at the back of the ship. The diameter of each jet is 155 mm. The total resistance offered to the motion of the boat is 4905 N. Determine: 10

(a) Volume of water drawn by the pump per second, and

(b) Efficiency of the jet propulsion.

Q4 a A jet of water having a velocity of 22 m/s strikes a curved vane, which is moving with a velocity of 11 m/s. The jet makes an angle of 21^0 with the direction of motion of vane at the inlet and leaves at an angle of 130^0 to the direction of motion of vane at an outlet. Calculate: 10

(i) Vane angles so that the water enters and leaves the vane without shock.

(ii) Work done per second per unit weight of water striking the vane per second.

(P.T.O.)

b The following data were obtained from a test on a pelton wheel: 10
(a) Head at the base of the nozzle = 32 m
(b) Discharge of the nozzle = 0.18 cumec.
(c) Area of the jet = 7500 sq.mm.
(d) Power available at the shaft = 44 Kw.
(e) Mechanical efficiency = 94%.
Calculate the power lost (i) in the nozzle; (ii) in the runner; (iii) in the mechanical friction.

Q5 a An inward flow reaction turbine operating under 30 m head, develops 4000 kW while running at 300 r.p.m. The overall efficiency of the turbine is 0.85; the hydraulic efficiency is 0.9; and the radial velocity of flow at inlet is 7 m/s; the inlet guide vane angle at full gate opening is 30^0. Calculate the diameter and width of the runner at inlet. Blade thickness coefficient is 5%. 10

b The propeller reaction turbine of runner diameter 4.5 m is running at 48 r.p.m. The guide blade angle at inlet is 145^0 and the runner blade angle at the outlet is 25^0 to the direction of vane. The axial flow area of water through the runner is 30 m^2. If the runner blade angle at inlet is radial, determine: 10
(i) Hydraulic efficiency of the turbine,
(ii) Discharge through the turbine, and
(iii) Power developed by the runner.

Q6 a A three stage centrifugal pump has impeller 400 mm in diameter and 20 mm wide. The vane angle at outlet is 45^0 and the area occupied by the thickness of the vanes may be assumed 8 % of the total area. If the pump delivers 3.6 m^3 of water per minute when running at 920 r.p.m. determine: 10
(i) Power of the pump,
(ii) Manometrichead,and
(iii) Specific speed.
Assume mechanical efficiency as 88% and manometric efficiency as 77%.

b A conical draft tube having inlet and outlet diameters 1 m and 1.5 m discharges water at outlet with a velocity of 2.5 m/s. The total length of the draft tube is 6 m and 1.3 m of the length of draft tube is immersed in water. If the atmospheric pressure head is 10.3 meters of water and loss of head due to friction in the draft tube is equal to 0.2 x velocity head at outlet of the tube, find Pressure head at inlet and efficiency of the draft tube 10